

**BY ORDER OF THE  
SECRETARY OF THE AIR FORCE**

**AIR FORCE INSTRUCTION 48-114**

**27 OCTOBER 2014**



***Aerospace Medicine***

**SWIMMING POOLS, SPAS AND HOT TUBS,  
AND NATURAL BATHING AREAS**

**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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Swimming Pools, Spas and Hot Tubs, and Natural Bathing Areas. This Swimming Pools, Spas and Hot Tubs, and Natural Bathing Areas Air Force Instruction (AFI) describes how the Air Force (AF) operates and maintains its swimming pools, public hot tubs and spas, and other bathing areas under its jurisdiction. This instruction applies to AF, the US Air Force Reserve, and the Air National Guard, and Direct Reporting units, and Field Operating Agencies which operate, maintain, and monitor swimming pools, hot tubs, spas, and natural bathing areas worldwide. It assigns responsibility for the healthful use and safe operation of bathing facilities and emphasizes the preventive medicine principles of hygiene and sanitation to ensure a clean, safe swimming and bathing environment. This AFI does not apply to water obstacles, although some information contained herein may be relevant. For installations with privatized housing swimming pools, installation Bioenvironmental Engineers shall work closely with Civil Engineering and the privatization agreement Contracting Officer's Representative to ensure AF requirements are met and both AF and system owner's responsibilities are clearly delineated and understood. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Form 847s from the field through Major Command (MAJCOM) publications/forms managers. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with AFMAN 33-363, *Management of Records*, and disposed of in accordance with Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS) located at <https://www.my.af.mil/afirms/afirms/afirms/afirms.cfm>. The authorities to waive wing/unit level requirements in this publication are identified with a Tier ("T-0, T-1, T-2, T-3") number

following the compliance statement. See AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items. This publication may be supplemented at any level, but all direct Supplements must be routed to the OPR of this publication for coordination prior to certification and approval. Use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force. The authority to collect and or maintain the records prescribed in this publication is Department of Defense Instruction (DoDI) 6055.1 *DoD Safety and Occupational Health (SOH) Program*.

## **SUMMARY OF CHANGES**

This publication revises AFI 48-114, dated 7 Mar 2012. The publication has been revised to streamline content and assign Tiers to requirements per AFI 33-360.

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## Chapter 1

### PROGRAM OVERVIEW

**1.1. Overview.** This publication establishes guidance and procedures for identifying, analyzing, and controlling health and safety risks from aquatic venues such as swimming pools, spas and hot tubs, therapeutic pools, spray pads, and natural bathing areas on AF installations. These procedures require collaboration among Bioenvironmental Engineering (BE), Civil Engineer (CE), Force Support Squadron (FSS), Public Health (PH), and Safety (SE). Many portions of this instruction were taken from ANSI/APSP-11 2009 *American National Standard for Water Quality in Public Pools and Spas* with permission from the Association of Pool & Spa Professionals (APSP).

**1.2. Safety and Health Risk.** Swimming pools, spas and hot tubs, and natural bathing areas can present multiple safety risks, such as drowning, slips and falls, and becoming caught in ladders, ropes, or drains. In addition, these facilities present health risks, including those associated with infectious disease, disinfection agents and their byproducts, and other contaminants which may be transmitted to humans via the water.

**1.2.1. Infectious Diseases.** Gastrointestinal Recreational Water Illnesses (RWI) are caused by the ingestion of water contaminated with pathogenic microorganisms including, but not limited to, *Cryptosporidium*, *Giardia*, *E.coli*, *Shigella*, and Norovirus. These microorganisms are spread in recreational water contaminated with fecal matter (e.g., swimmers with diarrhea or small children with toileting accidents). Other RWIs may be respiratory (caused by inhaling water droplets containing organisms such as *Legionella*) or dermal (caused by organisms such as *Pseudomonas*.) The microorganisms listed above are examples only and do not represent a complete list. Public Health (PH) can determine if there are threats from other microorganisms, including those endemic to the local area.

**1.2.2. Other Contaminants.** Non-microbial contaminants such as oils, lotions, leaves, and dirt are introduced by bathers. These can interfere with the clarity of the water, which increases the risk of injury due to poor visibility for swimmers. In addition, contaminants reduce the effectiveness of the sanitizer.

### 1.3. Regulatory Basis.

**1.3.1. Swimming Pools, Hot Tubs, and Spas.** There are currently no federal regulations governing water quality in swimming pools, hot tubs, and spas. In the absence of federal authority and subsequent inapplicability of state and/or local regulations, this instruction outlines the minimum requirements that shall be met.

**1.3.2. Natural Bathing Areas.** There are currently no federal regulations which prohibit swimming in natural bathing areas that exceed Clean Water Act water quality criteria. In the absence of federal authority, this instruction adopts the Environmental Protection Agency (EPA) criteria identified in Title 40, Code of Federal Regulations (CFR) Part 131, Water Quality Standards, as the minimum water quality criteria. This instruction will apply the most recent updates to 40 CFR 131. Any subsequent updates to 40 CFR 131 water quality criteria will apply on the date of implementation.

## Chapter 2

### ROLES AND RESPONSIBILITIES

**2.1. The Assistant Secretary of the Air Force for Installations, Environment, and Logistics (SAF/IE).** Responsible for providing guidance, direction, and oversight for Environment, Safety, and Occupational Health Programs.

**2.2. The Air Force Surgeon General (AF/SG).** Ensures AF swimming pools, hot tubs and spas, and natural bathing areas are properly surveyed, sampled, analyzed, and monitored to provide a healthy and safe swimming, bathing, and workplace environment. Establishes resources for health oversight of AF swimming pools, spas and hot tubs, and natural bathing areas to protect public health.

**2.3. The Air Force Medical Support Agency (AFMSA).** Develops AF implementation standards to promote a clean, healthful, and safe swimming environment and workplace.

**2.4. The Air Force Medical Operations Agency (AFMOA).** Oversees budgeting, programming, and execution of SG responsibilities for swimming pool, hot tub and spa, and natural bathing areas.

**2.5. The United States Air Force School of Aerospace Medicine (USAFSAM).** Provides technical guidance and consultative support for water quality and health risk assessments for AF swimming pools, spas, and hot tubs.(T-1)

**2.6. The Air Force Civil Engineer Center (AFCEC).** Provides technical assistance on environmental regulatory requirements and design and maintenance requirements related to swimming pools, spas and hot tubs, and natural bathing areas.

**2.7. The Air Force Safety Center (AFSEC).** Provides technical assistance on safety issues related to swimming pools, spas and hot tubs, and natural bathing areas.

**2.8. The Air Force Personnel Center – Services (AFPC - SV).** Develops policy and guidance related to day to day operation of AF swimming pools, spas and hot tubs, and natural bathing areas.

**2.9. Major Command (MAJCOM).** Provides technical assistance and policy guidance to installations to ensure the swimming pool, spa and hot tub, and natural bathing area programs conform to this instruction.

#### **2.10. Installation.**

**2.10.1. The Installation Commander.** Responsible for the overall operation and maintenance of swimming pools, hot tubs and spas, and natural bathing areas under Air Force jurisdiction.

##### **2.10.2. Base Civil Engineer.**

2.10.2.1. Constructs and maintains swimming pools, and spas and hot tubs as outlined in this instruction, AFI 32-1022 *Planning and Programming Nonappropriated Fund Facility Construction Projects*, AFMAN 32-1084 *Facility Requirements*, UFC 3-230-02 *O&M:Water Supply Systems*, UFGS 22-00-00 *Plumbing, General Purpose*, Public Law 110-140, *Energy Independence and Security Act of 2007*, December 19, 2007, and *Title*

15 United States Code Sections 8001-8008, *Virginia Graeme Baker Pool and Spa Safety Act*, as well as all other applicable federal, state and local laws. (T-0; see in-text citations)

2.10.2.2. Designates a pool treatment plant operator and ensure they maintain/operate the pool equipment and keeps records as outlined in this instruction and IAW UFC 3-230-02(T-0; see in-text citation)

2.10.3. **Ground Safety (SEG).** Provides consultation and advice related to safety issues for swimming pools, spas and hot tubs, and natural bathing areas. (T-1)

2.10.4. **Medical Group Commander.**

2.10.4.1. Approves locations of all natural bathing areas and provides oversight of water quality surveillance of swimming pools, hot tubs and spas, and natural bathing areas. Natural bathing area approvals shall be based on the considerations in Attachment 4. (T-1)

2.10.4.2. Approves use of primary sanitizers other than chlorine or bromine that meet performance standards defined by the EPA for swimming pool water. [http://www.epa.gov/oppad001/dis\\_tss\\_docs/dis-12.htm](http://www.epa.gov/oppad001/dis_tss_docs/dis-12.htm) (T-1)

2.10.5. **Public Health.**

2.10.5.1. Performs epidemiological monitoring for potential disease outbreaks associated with bathing areas according to AFI 48-105, *Surveillance, Prevention, and Control of Diseases and Conditions of Public Health or Military Significance* and reports potential recreational water illness (RWI) outbreaks to the appropriate offices. (T-1)

2.10.5.2. Provides oversight of sanitation practices for swimming pools, hot tubs, spas, natural bathing areas, showers and toilets. (T-1)

2.10.6. **Bioenvironmental Engineering (BE).**

2.10.6.1. Identifies, analyzes, and recommends controls for any occupational and environmental health (OEH) hazards due to daily operations, processes, and locations of pools, spas and hot tubs, and natural bathing areas. (T-1)

2.10.6.2. Provides water quality oversight of swimming pools, spas and hot tubs, and natural bathing areas under Air Force jurisdiction. (T-1)

2.10.6.3. Provides bacteriological monitoring in support of specific requests attributable to disease outbreaks. (T-1)

2.10.6.4. Reviews engineering designs for new and/or modified swimming pools, spas, and hot tubs and associated equipment and facilities to ensure adequacy of sanitary processes and controls. See Attachment 2 for potential considerations when reviewing bathing facility designs. (T-3)

2.10.7. **Force Support Squadron.**

2.10.7.1. **Outdoor Recreation Manager.**

2.10.7.1.1. Oversees the general day-to-day operation of public bathing facilities in accordance with AFI 34-110, *Air Force Outdoor Recreation Programs*, to provide

patrons with sanitary and safe conditions and employees with a safe, healthful workplace. (T-1)

2.10.7.1.2. Appoints, certified (where applicable), bathing facility personnel. (T-1)

2.10.7.1.3. Trains and equips lifeguards to perform required routine chemical testing, e.g. free available chlorine (FAC) measurements, and retains documentation of this training. Equipment and training will be approved by BE and CE prior to purchase/implementation. Ensure all staff members are properly trained in cleaning up body fluid spills on pool surfaces. Ensure BioHazard Kit is available to clean up blood or other potentially infectious material (OPIM) from pool decks or locker rooms. One kit is required per pool or waterfront. In accordance with AFI 34-110, *Air Force Outdoor Recreation Programs And Procedures*. (T-1)

2.10.7.1.4. Coordinates facility inspections with appropriate agencies. (T-2)

**2.10.7.2. Lifeguards.**

2.10.7.2.1. Enforce healthful safe pool practices and rules. (T-1)

2.10.7.2.2. Hold current lifesaving, first aid, and cardiopulmonary resuscitation (CPR) certifications in accordance with AFI 34-110. (T-1)

2.10.7.2.3. Perform routine chemical measurements outlined in this instruction. (T-1)

2.10.7.2.4. Complete the AF Form 708, *Swimming Pool Operational Log*, daily and as measurement requirements indicate. (T-2)

## Chapter 3

### GENERAL OPERATION AND MAINTENANCE

#### 3.1. Safety.

3.1.1. **Rules and Signs.** FSS shall clearly post signs with safety and warning guidelines as described below. (T-1)

3.1.1.1. **Establish/Coordinate.** FSS will establish rules in coordination with PH, and SEG. Rules must include at a minimum, the rules in Attachment 3.(T-1)

3.1.1.1.1. The rules must be posted so they are clearly visible to patrons entering the pool area or sitting in the spa or hot tub.(T-2)

3.1.1.1.2. A copy of these rules and this instruction shall be posted at the facilities for the bathing facility staff, pool operation, and patrons.(T-2)

3.1.1.1.3. Clearly post a sign in the immediate vicinity of the pool area stating the location of the nearest telephone and indicating emergency telephone (T-1)

3.1.1.2. **Natural Bathing Areas.** FSS in coordination with PH, and SEG shall jointly establish safety and warning guidelines for hazards particular to the bathing area. For example, marine bathing beaches shall warn swimmers of the possible presence of rip tides, jellyfish, stingrays, or other potentially dangerous aquatic life. Also, post a sign indicating that swimming with no lifeguard present is at the bather's own risk. If the area is to be marked, clearly define and mark swimming areas and mark the outermost limits at regular intervals with buoys or similar devices, bearing signs warning all watercraft to keep out. Post signs on offshore floats or rafts indicating whether or not diving is permitted. Clearly post a sign at a dedicated emergency phone, indicating emergency telephone numbers. (T-1)

3.1.2. **Pool Opening.** The outdoor recreation manager will coordinate with BE, PH, and Safety to conduct a pre-opening inspection of swimming pools, hot tubs and spas, and natural bathing areas before swimming season starts. FSS will approve the openings based upon the recommendations provided during the inspection. For facilities open year-round, semi-annual approvals are required. (T-1)

3.1.3. **Pool Closure.** The outdoor recreation manager shall immediately close the pool, spa, or hot tub if any of the following water quality conditions occur:

3.1.3.1. The water fails clarity test; (T-1)

3.1.3.2. The sanitizer or oxidation reduction potential (ORP) level is below minimum standard (see [Table 4.1](#)); (T-1)

3.1.3.3. The pH is outside the acceptable range; (T-1)

3.1.3.4. Fecal or vomit accident. (T-1)

3.1.4. **Emergency Preparedness.** The outdoor recreation manager shall prepare for emergencies by implementing the following requirements:



3.1.4.1. Maintain the required safety and rescue equipment in accordance with AFI 34-110, *Air Force Outdoor Recreation Programs and Procedures*. (T-1)

3.1.4.2. When feasible, ensure the availability of an Automatic External Defibrillator (AED). When available, the location of the AED shall be clearly marked and readily available for use in the event of emergency. (T-3)

3.1.5. **Adverse Weather Conditions.** The outdoor recreation manager shall follow procedures in AFI 91-203, *Air Force Consolidated Occupational Safety Instruction* when lightning or other adverse weather conditions are present. (T-1)

**3.2. Sanitation.** The outdoor recreation manager shall maintain a sanitary pool environment by implementing the following requirements:

3.2.1. Clean toilets, shower facilities, and dressing rooms in accordance with AFI 48-117, *Public Facility Sanitation*. (T-1)

**3.2.2. Swimming Pools, Spas, and Hot Tubs.**

3.2.2.1. Drain and clean recirculation filter pools, spas, and hot tubs in accordance with **paragraph A6.1.15**. Coordinate draining with designated CE personnel. (T-2)

3.2.2.2. Clean pools daily with a suction cleaner or other bottom-cleaning device. (T-2)

3.2.2.3. Drain and clean non-circulation wading pools with a 50 parts per million (ppm) chlorine solution daily, and as necessary. **Note:** To mix a 50 ppm chlorine solution, add one teaspoon of household bleach to each gallon of water. (T-2)

3.2.2.4. Ensure pools, spas, and hot tubs equipped with overflow gutters are overflowed each day to remove scum and surface debris. Maintain the water in pools equipped with only surface skimmers at a level such that the skimmer continuously operates. (T-2)

3.2.2.5. Ensure pool deck/apron and area surrounding a spa/hot tub are free of debris. Furthermore, when pooling of water occurs on pool deck and if matting is used over a concrete surface (such as ventilated plastic matting), routinely clean the surface with a 50 ppm chlorine solution. (T-2)

**3.2.3. Natural Bathing Areas.**

3.2.3.1. Establish and follow cleaning and maintenance (e.g., raking) schedules for managed beach areas. (T-3)

3.2.3.2. Designate picnic areas near the beach and provide waste receptacles. Prohibit picnicking and bottles and cans for food and drink on the beach proper. (T-3)

**3.3. Pool treatment plant operation.** (**Note:** Explanations of the different types of swimming pool treatment are provided in Attachment 5.)

3.3.1. The pool treatment plant operator shall maintain a piping diagram of water and sewer lines and post a copy near the pool chemical equipment. (T-1)

3.3.2. During months that pools are open, the pool treatment plant operator shall complete the monthly operating checklist for swimming pools, as written in the Unified Facilities Criteria 3-230-02, Operation and Maintenance: Water Supply Systems, 10 Jul 01. (T-0; see in-text citation)

3.3.3. The pool treatment plant operator shall ensure excess pool water is discharged to the local sanitary sewer in compliance with local treatment works ordinances, dechlorination requirements and AFI 32-7041, *Water Quality Compliance*. (T-0; 40 CFR 122)

## Chapter 4

### WATER QUALITY AND MONITORING

#### 4.1. Swimming Pools, Hot Tubs, and Spas.

4.1.1.1. **Source Water.** The pool treatment plant operator shall ensure the pool water comes from an approved drinking water source. (T-1)

4.1.1.2. **Chemical Operational Parameters.** (Note: Definitions and discussion of the parameters mentioned here are provided in [Attachment 6](#).)

4.1.2.1. The pool treatment plant operator shall measure for those parameters indicated in Table 4.1 at intervals specified, making corrective actions to meet the guidelines or informing the facility manager of additional treatments recommended. (T-1)

4.1.2.2. The outdoor recreation manager or lifeguard shall measure for those parameters indicated in [Table 4.1](#) at intervals specified. pH, temperature, and disinfectant residual level of spas/hot tubs shall be measured prior to daily opening, and at all corners of the pool at least once every two hours during operation, entering the average of the values on the AF Form 708. If results are outside the acceptable range indicated in [Table 4.1](#), close the pool and contact BE and the pool treatment plant operator. (T-1)

4.1.2.3. **Quality Assurance Check.** At least once every 30 days during outdoor pool season, BE will perform a quality assurance check of the lifeguard's pH and disinfectant residual measuring skills. BE will measure the pH and disinfectant residual levels, enter the results on the AF Form 708, and compare the results to the lifeguard's readings. If the readings differ significantly, BE shall determine the cause of the discrepancy and ensure the lifeguards are following the correct measurement procedures. BE shall increase the frequency of quality assurance checks if needed to ensure discrepancies are corrected. Measurements shall be made by lifeguard at times of heavy use. (T-1)

4.1.2.4. **Increased Risk Aquatic Venues.** Water quality monitoring and chemical operational parameters for therapy pools, spray pads, and wading pools shall be the same as defined for swimming pools in [Table 4.1](#).

4.1.2.5. The Medical Group Commander may establish more stringent or specific monitoring requirements than outlined in this instruction.

**Table 4.1. Water Quality Requirements for Swimming Pools, Hot Tubs and Spas.**

Parameter	Acceptable Range	Applicability	Monitoring Frequency	Responsible Organization
Free available chlorine (FAC)*	1.0 – 4.0 ppm	Pools	Every 2 hours	Outdoor recreation manager or lifeguard
	2.0 – 5.0 ppm	Spas & Hot Tubs	Every hour	
Bromine	1.0 – 8.0 ppm	Pools	Every 2 hours	Outdoor recreation manager or lifeguard
	2.0 – 8.0 ppm	Spas & Hot Tubs	Every hour	
pH	7.2 -7.8	Pools, Spas, & Hot Tubs	Every two hours	Outdoor recreation manager or lifeguard

Parameter	Acceptable Range	Applicability	Monitoring Frequency	Responsible Organization
Total alkalinity	60 – 180 ppm	Pools	Once per week	Outdoor recreation manager or lifeguard
		Spas & Hot Tubs	Daily	
Calcium hardness	150 – 1,000 ppm as CaCO <sub>3</sub>	Pools	Every 2 weeks	Pool Treatment Plant Operator
	100 – 800 ppm as CaCO <sub>3</sub>	Spas & Hot Tubs		
Total Dissolved Solids (TDS)	NTE 1500 ppm above the concentration at startup	Pools, Spas, & Hot Tubs	Every 2 weeks	Pool Treatment Plant Operator
Clarity	An 8-inch diameter black and white Secchi disc or the main drain located on the bottom of the pool at its deepest point must be clearly visible and sharply defined from any point on the deck up to 30 ft away in a direct line of sight from the disc or main drain.	Pools	Daily	Outdoor recreation manager or lifeguard
	The bottom of the spa at its deepest point shall be clearly visible. Perform this test when water is in a non-turbulent state and bubbles have dissipated.	Spas & Hot Tubs		Outdoor recreation manager or lifeguard
CYA	Ideal concentration is between 25-50 ppm, but must not exceed 100 ppm	Pools, Spas, & Hot Tubs using CYA as a stabilizer	Monthly; for salt water pools monitoring may be required more frequently - consult the manufacturers' instructions for appropriate frequency	CE, if used
Oxidation	Greater than 720 mV	Not a required	Not a required	CE, if used

Parameter	Acceptable Range	Applicability	Monitoring Frequency	Responsible Organization
Reduction Potential (ORP)	if using a silver/silver chloride electrode; Greater than 680 mV if using a calomel electrode	parameter; however may supplement direct measurement of sanitizer residual as indicator of water quality	parameter; if used, recommend at least daily readings	
Salt		Pools, Spas, & Hot Tubs using in-line electrolytic chlorinators	Per the manufacturer’s instructions	CE, if used
Temperature	78°F - 82°F	Pools	Every two hours	Outdoor recreation manager or lifeguard
	78°F - 80°F	Competitive events/training		
	Maximum 104°F	Spas & Hot Tubs		
Algae	No visible algae when open to swimmers	Pools, Spas, & Hot Tubs	Continuous	Outdoor recreation manager or lifeguard
Combined chlorine	0.2 ppm	Pools	Every hour	Outdoor recreation manager or lifeguard
	0.5 ppm	Spas & Hot Tubs		
*It is important to note the differences in FAC levels for responding to diarrheal vs. formed stool and vomit incidents. A diarrheal incident has a higher risk of <i>Cryptosporidium</i> and requires a more robust response, as described in Attachment 6.				

4.1.3. **Test Kits.** Water quality test kits shall be stored as specified by the manufacturer's instructions. Improper storage can cause the kits to function improperly. (T-1)

4.1.4. **Hyperchlorination.**

4.1.4.1. The pool treatment plant operator shall super chlorinate the pool as necessary to correct poor water quality.

4.1.4.2. The pool treatment operator shall annotate each shock treatment on AF Form 708.

4.1.4.3. The contact time (CT) inactivation values indicate the approximate disinfection time required to inactivate specific microorganisms. CT values are defined as the concentration of free chlorine in ppm multiplied by time in minutes at a specific pH and temperature. See [Table 4.2](#) for a list of CT inactivation values sufficient to inactivate some microorganisms commonly found in pool/spa water. Other CT values may be used as long as they are consistent with 40 CFR 141.74. For sanitizers other than chlorine, follow manufacturer's guidelines. *Cryptosporidium* is a chlorine-resistant microorganism, and the recommendations provided by the CDC fact sheet "Hyperchlorination to Kill *Cryptosporidium*" shall be reviewed prior to any hyperchlorination intended to inactivate it. (T-1)

**Table 4.2. CT Inactivation Values**

(Applicable for water conditions of 1 ppm FAC, pH 7.5 or less, and temperature 77°F or more)	
Agent	Disinfectant Times for Fecal Contaminants in Chlorinated Water
<i>E. coli</i> O157:H7	Less than 1 minute
Hepatitis A	Approximately 16 minutes
<i>Giardia</i>	Approximately 45 minutes
<i>Cryptosporidium</i>	Approximately 15,300 minutes (10.6 days)
<i>Note: These values are only for pools that do not use a chlorine stabilizer such as CYA. Disinfection times would be longer in the presence of a stabilizer.</i>	

**4.2. Natural Bathing Areas.**

**4.2.1. Risk-Based Sampling.** BE shall perform water quality sampling at natural bathing areas based on risk. Risk factors to consider include, but are not limited to, proximity to suspected pollution sources, level of bathing area use, historical water quality data, and occurrence of sewage spills or other pollution events. If local or state regulatory agencies have current data, those data may be used and BE can determine what, if any, additional parameters need to be evaluated. If BE decides not to sample at natural bathing areas, the rationale behind the decision shall be documented. This documentation must be reviewed and updated at least annually. (T-2)

**4.2.2. Sampling Methods.** If bacteriological sampling is conducted, refer to 40 CFR 131.41 for guidance. *E.coli* and *Enterococci* shall be used as the indicator organisms for evaluating the microbiological suitability of the water in freshwater natural bathing areas. *Enterococci* shall be used as the indicator organism in marine waters, and Enterolert® or any equivalent method that measures viable criteria, as indicated in 40 CFR 136 shall be used. For *E.coli*, Colilert® or any equivalent method that measures viable criteria, as indicated in 40 CFR part 136 shall be used. All sampling shall follow guidance in *Standard Methods for the Examination of Water and Wastewater*, current edition. The use of certified laboratories for bacteriological analyses is not required if BE adheres to Standard Methods. (T-0; 40 CFR 131)

**4.2.3. Additional Sampling.** If a bacterial concentration exceeds the applicable water quality standard identified in 40 CFR 131.41, or a storm, sewage spill, or pollution event occurs that could affect the natural bathing area, additional sampling shall be conducted. (T-1)

**4.3. Bacteriological Monitoring.** BE will provide bacteriological monitoring only in support of specific requests attributable to disease outbreaks. (T-1) If bacteriological water quality of pools, spas/hot tubs, or natural bathing areas does not meet standards, BE shall:

4.3.1. Collect repeat samples from the points of previous collection. (T-1)

4.3.2. Conduct an immediate investigation to determine if any unusual conditions such as repairs to facilities, storms, spills, etc. might have caused a problem. For pools and spas/hot

tubs, CE shall determine if the filtration and disinfection systems have been operating properly. (T-1)

4.3.3. Ensure pH and disinfectant residuals are within acceptable ranges for pools and spas/hot tubs. (T-1)

4.3.4. Notify PH whenever conditions are encountered which may pose a health hazard to patrons. (T-1)

4.3.5. If the results of the resample again exceed standards, shock treatment of pools and spas/hot tubs may be required. (T-1) the Medical Group Commander or designated representative shall recommend closing the facility until the cause of the problem is determined.

4.3.6. PH shall take any measures deemed necessary to initiate surveillance or investigate the occurrence of illnesses associated with unhealthy water quality. (T-1)

#### **4.4. Responding to a Fecal, Vomit, or Blood Incident.**<sup>1</sup>

4.4.1. **Recordkeeping.** Outdoor recreation managers shall document each incident by recording date and time of the event, whether it involved vomit, blood, formed stool or diarrhea, and the free chlorine and pH levels at the time of observation of the event. Before reopening the pool, record the free chlorine and pH levels, the procedures followed in response to the incident (including the process used to increase chlorine levels if necessary), and the contact time. (T-1)

4.4.2. **Pool Closure.** In the case of a fecal or vomit incident, close the pool or spa until the disinfection process has been completed in accordance with Centers for Disease Control and Prevention (CDC) guidelines in Attachment 7. (T-1)

4.4.3. **Water Treatment.** In the case of a fecal or vomit incident, the FAC level in the pool/spa water shall be raised to the appropriate level and maintained for the appropriate contact time (CT). Specific procedures for the type of incident are in Attachment 6. (T-1)

4.4.4. **Blood Incident.** The chlorine in properly chlorinated pool water quickly kills microorganisms in blood. There is no public health reason to close the pool after a blood spill; however pool staff may choose to do so for aesthetic reasons to satisfy patrons.

THOMAS W. TRAVIS, Lieutenant General,  
USAF, MC, CFS  
Surgeon General

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<sup>1</sup> Centers for Disease Control and Prevention. *Fecal Incident Response Recommendations for Pool Staff*. 15 Nov 2010. <http://www.cdc.gov/healthywater/swimming/pools/vomit-blood-contamination.html>

## Attachment 1

## GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

*References*

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World Health Organization. *Guidelines for Safe Recreational Water Environments, Vol. 2: Swimming Pools and Similar Environments*, 2006.

### ***Prescribed Forms***

AF Form 708, *Swimming Pool Operational Log*

### ***Adopted Forms***

AF Form 847, *Recommendation for Change of Publication*

Environmental Protection Agency. *2012 Recreational Water Quality Criteria*, December 2012.

### ***Abbreviations and Acronyms***

**AED**—Automated External Defibrillator

**AFI**—Air Force Instruction

**AFMAN**—Air Force Manual

**AFMSA**—Air Force Medical Support Agency

**AFOSH**—Air Force Occupational Safety and Health

**AFRIMS**—Air Force Records Information Management Systems

**AFPC-SV**—Air Force Personnel Center – Services

**AFSEC**—Air Force Safety Center

**ANSI**—American National Standards Institute

**APSP**—Association of Pool and Spa Professionals

**ASHRAE**—American Society of Heating, Refrigeration, and Air Conditioning Engineers

**BE**—Bioenvironmental Engineering

**CaCO<sub>3</sub>**—Calcium Carbonate

**CDC**—Centers for Disease Control and Prevention

**CFR**—Code of Federal Regulations

**CDC**—Centers for Disease Control and Prevention  
**CE**—Civil Engineer  
**CPR**—Cardiopulmonary Resuscitation  
**CT**—Contact Time  
**DBP**—Disinfection By-Products  
**EPA**—Environmental Protection Agency  
**FAC**—Free Available Chlorine  
**FSS**—Force Support Squadron  
**HOBr**—Hypobromous Acid  
**HOCl**—Hypochlorous Acid  
**MAJCOM**—Major Command  
**mV**—millivolts  
**NaCl**—Sodium chloride  
**OCl**—Hypochlorite  
**PH**—Public Health  
**pH**—A measure of the acidity or basicity of an aqueous solution  
**ppm**—Parts per million (equivalent to milligrams per liter)  
**OEEL**—Occupational and Environmental Exposure Limit  
**OEH**—Occupational and Environmental Health  
**OPR**—Office of Primary Responsibility  
**ORP**—Oxidation Reduction Potential  
**PPE**—Personal Protective Equipment  
**RDS**—Records Disposition Schedule  
**RWI**—Recreational Water Illnesses  
**SCBA**—Self Contained Breathing Apparatus  
**SEG**—Ground Safety  
**UFC**—Unified Facilities Criteria  
**UFGS**—Unified Facilities Guide Specifications  
**USAFSAM**—United States Air Force School of Aerospace Medicine  
**UV**—Ultraviolet  
**TDS**—Total Dissolved Solids  
**WHO**—World Health Organization

## Attachment 2

### REVIEWING BATHING FACILITY DESIGNS

#### A2.1. Consider:

A2.1.1. Drains sized to prevent entrapment and avoid suction injuries.

A2.1.2. Circulation equipment sized to ensure the proper turnover rate as described in [paragraph A6.2](#)

A2.1.3. Filters sized to accommodate proper turnover rate.

A2.1.4. Pool sized to accommodate expected bather load. The bather load is calculated as one bather per 15 square feet of surface area in portions of the pool that are 5 feet deep or less (shallow end), and one bather per 20 square feet of surface area in portions of the pool that are more than 5 feet deep (deep end). Subtract 300 square feet from the total surface area of the deep end for each diving board.

A2.1.5. For increased risk aquatic venues such as spray pads, wading pools, and therapy pools: supplemental, optimally-designed in-line disinfection, e.g., ozone or UV light, which can inactivate *Cryptosporidium* and potentially improve water quality.

A2.1.6. Automatic chemical feeders to improve the uniformity of chemical addition.

A2.1.7. Filters that are sized and optimized for particle and microbe removal.

A2.1.8. Dedicated filters for wading pools/baby pools, to prevent cross-contamination of other pools.

A2.1.9. Wading pool/baby pool turnover rates that decrease the length of time swimmers are exposed to germs and include safety considerations for avoiding drain entrapment and suction injuries.

A2.1.10. Adequate ventilation for indoor facilities to decrease exposure to chloramines and other pool-water byproducts. See American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62.1, *Ventilation for Acceptable Indoor Air Quality* and *2011 ASHRAE Handbook HVAC Applications* for guidance. The latter document has specific design information regarding indoor pools, also known as natatoriums. AF personnel can download these publications from the online Whole Building Design Guide, at <http://www.wbdg.org>.

A2.1.11. Adequate numbers of easily located, close, and safe restrooms, diaper changing areas, and shower facilities to promote good swimmer hygiene. See *Unified Facilities Criteria 3-420-01: Plumbing Systems*, Table 403-5 for guidance. AF personnel can download a copy of this standard from the online Whole Building Design Guide, at <http://www.wbdg.org>.

A2.1.12. Diaper changing and hand washing facilities near children's pools to promote good hygiene and diaper changing practices among parents.

A2.1.13. Utilize the Reference National Sanitation Foundation sources during modification to swimming pool systems. Reference: <http://www.nsf.org/consumer-resources/what-is-nsf-certification/pool-spa-certification/>"

### **Attachment 3**

## **SAFETY AND HEALTH RULES**

### **A3.1. Swimming Pools.**

A3.1.1. Children 10 or younger shall be under the direct supervision of an adult.

A3.1.1.1. Children 11 - 13 shall pass a swim test or be supervised by an adult.

A3.1.1.2. Children not toilet trained shall wear swim diapers.

A3.1.2. No diving into shallow water

A3.1.3. No breath holding or prolonged underwater swimming contests.

A3.1.4. Food, beverages, chewing gum, and smoking prohibited in pool and on pool apron.

A3.1.5. Glass containers prohibited in pool area.

A3.1.6. Individuals experiencing the following conditions shall be prohibited from entering the pool: diarrhea, skin disease, open sores or lesions, including live immunizations, sore or inflamed eyes, nasal or ear discharge.

A3.1.7. No pets are allowed in the pool area. (Service dogs escorting persons with disabilities shall be permitted on the pool apron and in restrooms. Also, working dogs accompanied by handlers shall be permitted in swimming pool areas as required.

A3.1.8. Showers are required before entering pool.

A3.1.9. Lifeguards will clear pools or beach areas during electrical storms and at other times deemed necessary in the interest of safety.

### **A3.2. Spas/Hot Tubs.**

A3.2.1. In addition to the rules listed above, add:

A3.2.2. Pregnant women, elderly persons, and persons suffering from heart disease, diabetes, or high or low blood pressure shall not enter the spa/hot tub without prior medical consultation and permission from their doctor.

A3.2.3. Do not use the spa/hot tub while under the influence of alcohol, tranquilizers, or other drugs that cause drowsiness or that raise or lower blood pressure.

A3.2.4. Do not use at water temperatures above 104°F.

A3.2.5. Do not use alone.

A3.2.6. Unsupervised use by children prohibited.

A3.2.7. Children under five years old are not permitted in spas/hot tubs.

A3.2.8. Enter and exit slowly.

A3.2.9. Observe reasonable time limits (10-15 minutes), then leave the water and cool down before returning; long exposure may result in nausea, dizziness, or fainting.

#### Attachment 4

### CONSIDERATIONS FOR SITING OF NATURAL BATHING AREAS

**A4.1. Site Location.** Consider effects of point and nonpoint pollution sources. Sources of potentially dangerous contamination include (but are not limited to) waste discharges from communities, agriculture, industries, marine craft, local animal populations, and water fowl.

**A4.2. Type of Bottom.** These areas should have floors which slope gently and uniformly toward deep water; have no holes or sudden step-offs; be free of hidden or submerged obstructions such as rocks, stumps, snags, and sunken logs; be composed of firm sand, small-sized gravel, or shale; have no silt, quicksand, shell patches, sharp and broken rock, or debris in depths of 5 ft (1.5 m) or less.

**A4.3. Physical Water Quality.** Consider the depth and turbidity of the water, presence of currents, rip tides, and dangerous aquatic flora and fauna.

**A4.4. Common Diseases.** Natural bodies of water located in areas where schistosomiasis (bilharziasis), leptospirosis, or primary amoebic meningoencephalitis are endemic shall not be approved for recreational purposes without the concurrence of the public health or preventive medicine officer. PH shall be consulted to determine if there are threats from other microorganisms, including those endemic to the local area.

## Attachment 5

### TYPES OF SWIMMING POOL, SPA AND HOT TUB TREATMENT<sup>2</sup>

**A5.1. Background.** Many chemical substances sold or distributed in the United States must be registered by the Environmental Protection Agency (EPA). This includes disinfectants and sanitizers such as chlorine and bromine used in swimming pools and spas. (It is important to note that an EPA-registered sanitizer does not kill all bacteria in the pools or spas, but controls them and reduces their opportunity to spread disease.) A measurable amount, known as a “residual,” of an EPA-registered sanitizer shall be present at all times and in all areas of the swimming pool or spa. Any system used shall incorporate an EPA-registered sanitizer. Follow the product manufacturer’s EPA-accepted label for use and/or operation requirements.

**A5.2. Sanitizers.** Sanitizers currently approved for use by the EPA are chlorine, bromine, polyhexamethylene biguanide (PHMB), and silver-based systems. However, chlorine and bromine are the most commonly used.

**A5.2.1. Chlorine.** Chlorine is the most common sanitizer used in pool and spa treatment. In this method, chlorine in a liquid, powder, tablet, or gas form is added to the pool water. Chlorine generators are an alternative method of chlorination. Instead of adding chlorine directly, chlorine generators use salt (NaCl) brine in an electrolytic cell to produce chlorine in the pool. Chlorine reacts with the pool water to form hypochlorite (OCl<sup>-</sup>) and hypochlorous acid (HOCl) which kills pathogens. Combined chlorine, also known as chloramines, can form when free chlorine reacts with amine-containing compounds (proteins and ammonia from perspiration and urine). These compounds can cause eye, mucous membrane, and skin irritation and have strong objectionable odors. Chlorine tends to degrade in sunlight. A stabilizer such as cyanuric acid may be used to counteract this degradation.

**A5.2.1.1. Cyanuric acid (CYA).** Cyanuric acid is available as either CYA or as chlorinated isocyanurate. CYA stabilizes chlorine by loosely binding to chlorine and thus inhibiting degradation by UV in sunlight. However, binding with chlorine decreases the disinfectant effectiveness. At CYA concentrations in the range of 100-200 ppm, binding results in a condition termed “chlorine lock” in which disinfection is ineffective. CYA does not degrade. Hence, the pool must be overflowed or partially drained and refilled in order to reduce CYA concentrations. The optimum concentration for CYA is 25-50 ppm. Use of CYA in indoor pools or with bromine disinfectant is prohibited.

**A5.2.2. Bromine.** If bromide salt is used, an oxidizer (such as HOCl) is required for the conversion of bromide to hypobromous acid (HOBr). Bromochlorodimethylhydantoin (BCDMH) is an alternate method for generating HOBr. BCDMH generates both HOCl and HOBr. The HOCl is consumed first, leaving HOBr as the disinfectant. Bromine is effective over a wider pH range than chlorine, but cannot be stabilized against degradation by sunlight (CYA cannot be used with bromine). In the same way that chlorination can result in chloramines, bromination can result in byproducts called bromamines. However, bromamines are not known to be harmful at concentrations normally found at swimming

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<sup>2</sup> The Association of Pool and Spa Professionals. ANSI/APSP-11 2009. *American National Standard for Water Quality in Public Pools and Spas*, 15 June 2009.

pools, spas, and hot tubs. Of note, a pool disinfected with bromine cannot be converted to chlorine disinfection without draining and refilling.

**A5.2.3. Polyhexamethylene biguanide (PHMB).** PHMB is an effective pool and spa sanitizer. Its advantages include minimal degradation in sunlight and low eye and skin irritation. Its disadvantages are high costs, the need for additive chemicals as algicides, and lack of understanding of compatibility with other pool chemicals (for example, chlorine degrades PHMB). Because of these disadvantages, PHMB is not recommended for AF owned or operated pools and spas.

**A5.2.4. Supplemental sanitizers.** Ozone and ultraviolet (UV) light are types of supplemental (optional) sanitizers. A benefit of systems that use supplemental sanitizers is that they use less chlorine than chlorination alone. In addition, supplemental sanitizers are especially effective against some chlorine-resistant microorganisms, such as *Cryptosporidium* and *Giardia*. However, these supplemental sanitizers do not provide a lasting disinfectant effect or residual that reaches the pool and continues to act upon chemicals and microorganisms in the water. Because of this, they are not adequate for stand-alone uses.

**A5.2.4.1. Ozone.** Ozone is generated onsite at the point of use. When ozone is used for indoor facilities, air monitoring may be required within the enclosed swimming pool area. For installations using ozone, coordinate with USAFSAM for guidance on the need for air monitoring and appropriate occupational and environmental exposure limits. (There is limited research discussing the hazard of ozone in indoor swimming pools.)

**A5.2.4.2. UV.** UV light can be used for disinfection but the pool water shall be treated beforehand to meet manufacturer's recommendations (including filtration) for the color, turbidity, particulate size and chemical composition. Note: UV degrades hypochlorite/hypochlorous acid to chloride ion (bromine to bromide) and thus interferes with maintaining disinfectant residuals.

**A5.2.4.3. Silver-based sanitizers.** Silver is used as an antibacterial agent in many applications, including swimming pool sanitizers. Positively charged silver ions attach to negatively charged contaminants and destroy them. On AF installations, silver shall not be used as a primary sanitizer but may be used as a supplemental sanitizer.

**A5.3. Filters.** <sup>3</sup> Filters are not designed to remove bacteria, but are designed to improve clarity of pool water. Water clarity is important to identify swimmers in distress, and so swimmers can see potential underwater hazards. In addition, particulates negatively interfere with the disinfection process. Filters shall be sized to accommodate the appropriate pool turnover rate as described in [paragraph A6.2](#). There are a number of types of filters available. The choice of filter will be based on several factors, including quality of source water; amount of filter area available and number of filters; filtration rate; ease of operation; method of backwashing; and degree of operator training required. Typically the higher the filtration rate, the lower the filtration efficiency.

**A5.3.1. Cartridge filters.** Cartridge filters can nominally filter down to 10-20 microns and last up to two years. The filter medium is spun-bound polyester or treated paper. Cleaning is

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<sup>3</sup> World Health Organization. *Guidelines for safe recreational water environments. Volume 2: Swimming pools and similar environments.* 2006.

achieved by removing the cartridge and washing it. The main advantage is the relatively small space requirement compared with other filter types, and they are often used with small pools and hot tubs.

**A5.3.2. Sand filters.** Medium-rate sand filters can nominally filter down to 30 microns in size with the addition of a suitable coagulant. A coagulant is needed for a sand filter to perform optimally. To clean sand filters, pool operators perform manual reverse flow backwashing.

**A5.3.3. Diatomaceous earth filters.** These filters use replaceable diatomaceous earth filter medium added after each backwash. Diatomaceous earth filters particles 3-5 microns and has been reported to filter 99.9% of *Cryptosporidium* when operated and maintained correctly. Discharge of chlorinated water or filters containing chlorinated water may be prohibited by local state or city ordinances. Verify local and state requirements prior to discharge or disposal.



## Attachment 6

## WATER QUALITY IN SWIMMING POOLS, SPAS, AND HOT TUBS

A6.1. Chemical Operational Parameters. <sup>4</sup>

A6.1.1. **FAC.** Free available chlorine (FAC) is the indicator used to measure the level of sanitizer residual for chlorination systems. For swimming pools, a minimum FAC residual of 1.0 ppm shall be maintained at all times and in all areas of the pool. A maximum of 4.0 ppm shall not be exceeded when the pool is open to swimmers. For spas and hot tubs, the FAC shall be between 2.0 – 5.0 ppm. Chlorine disinfectants will dissipate quicker than bromine and mineral stabilizers in the higher temperatures of spas and hot tubs. [Table 4.2](#) shows the amount of time, known as the inactivation time, required to control the organisms of interest in recreational waters with 1.0 ppm free chlorine residual.

A6.1.2. **Bromine.** If bromine is used, a minimum residual of 1.0 ppm (as Br<sub>2</sub>) shall be maintained at all times and in all areas of the pool. A maximum of 8.0 ppm (as Br<sub>2</sub>) shall not be exceeded when the pool is open. For spas, the bromine residual shall be between 2.0 – 8.0 ppm. If a chlorine DPD test kit is used to measure bromine, the FAC reading shall be multiplied by 2.25 to obtain the bromine concentration.

A6.1.3. **Ozone.** If an ozone supplemental sanitizer is used, especially for an indoor pool, air monitoring may be required (see [paragraph A5.2.4.1](#)). In addition, CE shall periodically leak check for gaseous ozone at the ozone generator.

A6.1.4. **pH.** pH shall be maintained within a range of 7.2 – 7.8 to ensure optimal performance of the sanitizer. If the pH is higher than this range, the HOCl concentration will not be high enough to adequately sanitize. If the pH is below this range, chlorine gas could form which is a health hazard to swimmers, and also wastes chlorine that could be used in the pool.

A6.1.5. **Total alkalinity.** Alkalinity is the measure of the ability of water to resist a pH change, known as the buffering capacity. A total alkalinity of 60 ppm – 180 ppm shall be maintained.

A6.1.6. **Calcium hardness.** Calcium concentration shall be kept below the maximum to avoid production of scale and cloudy water. Maintain a calcium (or Langelier) saturation index between -0.3 and +0.5. The acceptable range for pool water is 150 ppm – 1,000 ppm as CaCO<sub>3</sub>, and ideally between 200 ppm – 400 ppm. The acceptable range for hot tub/spa water is 100 ppm – 800 ppm as CaCO<sub>3</sub>, and ideally between 150 ppm – 250 ppm.

A6.1.7. **Total Dissolved Solids (TDS).** TDS is a measure of all the dissolved ions in the water. TDS can decrease efficacy of sanitizers and cause water to become cloudy or hazy. The TDS level in pool/spa shall not exceed 1,500 ppm above the TDS level of pool startup concentration.

A6.1.8. **Clarity.** Water clarity is important to identify swimmers in distress, and so that swimmers can see potential underwater hazards. In addition, particulates can negatively

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<sup>4</sup> The Association of Pool and Spa Professionals. ANSI/APSP-11 2009. *American National Standard for Water Quality in Public Pools and Spas*, 15 June 2009.

interfere with the disinfection process. Clarity is measured by using a Secchi disk, as described in [Table 4.1](#)

**A6.1.9. Cyanuric Acid.** CYA, if used, shall be maintained between 25-50 ppm. 100 ppm is the maximum allowable. Use of stabilized chlorine products (e.g. di-chlor or tri-chlor) in an erosion feeder will eventually lead to exceeding approved levels. If using a chlorinated isocyanurate to maintain FAC, CYA levels shall be checked weekly. Only qualified personnel use stabilized chlorine tablets and monitor CYA levels within recommended limits to reduce chlorine loss in outdoor pools. Tablets of dichlor and trichlor are chlorinated isocyanurates solid compounds that contribute CYA to pool water to reduce the loss of free chlorine by the sun's ultraviolet rays. However, excessive CYA can reduce the effectiveness of chlorine with some species of pathogens. CYA should not be used in hot tubs or spas because chlorine effectiveness is significantly weakened in the presence of CYA.

**A6.1.10. Oxidation reduction potential (ORP).** The oxidation–reduction potential (also known as ORP or redox) can also be used in the operational monitoring of disinfection efficacy. ORP measures the effectiveness of disinfectant in the swimming pool water by providing an indication of the capacity of the disinfectant to oxidize or sanitize organic contaminants. ORP is measured in units of millivolts (mV) with a handheld meter. The ORP value corresponds to an approximate level of oxidizing sanitizer such as chlorine or bromine. In general terms for swimming pools and similar environments, levels in excess of 720 mV (measured using a silver/silver chloride electrode) or 680 mV (using a calomel electrode) suggest the water is in good microbial condition. However, measuring ORP does not eliminate the need for testing sanitizer levels with standard test kits. Installations operating an ORP system should consult manufacturer documentation to investigate whether the system can reach the acceptable range for FAC.

**A6.1.11. Temperature.** The temperature of hot tub/spa water must never exceed 104°F.

**A6.1.12. Bacteria.** Because the deterioration of water conditions is difficult to measure through regular monitoring, water quality parameters must be maintained in accordance with this instruction. This will ensure safe quality water while avoiding the expense of unnecessary continuous bacteriological sampling.

**A6.1.13. Algae.** Algae can affect the health and safety of swimmers by harboring disease-causing organisms, causing slippery pool floors, and raising the turbidity in a pool. Algae can be very difficult to eliminate once it gets established in a pool. Maintaining proper sanitizer levels is the best method of prevention. There is no requirement to perform testing for algae, but if it is observed, immediate action shall be taken to remove it.

**A6.1.14. Combined chlorine.** Combined chlorine, also known as chloramines, can form when free chlorine reacts with amine-containing compounds, e.g., proteins and ammonia from perspiration and urine. These compounds can cause eye, mucous membrane, and skin irritation and have strong objectionable chlorine-type odors. Combined chlorine concentrations are obtained by subtracting the measured FAC from the measured total chlorine concentration. The maximum level for combined chlorine is 0.2 ppm in pools and 0.5 ppm in spas.

**A6.1.15. Water Replacement.** Many contaminants enter pool and spa water from the environment, from the bathers themselves, and from byproducts of chemicals used to treat

the water. Although filtration and oxidation are effective in removing many of these contaminants, many of them remain and accumulate in the water. In pools and spas, water replacement is generally the only practical way to correct for excessive contaminants, calcium hardness, TDS, and CYA. Water replacement can be accomplished by periodic draining or continuous dilution; however, continuous dilution does not preclude the need for periodic draining and thorough cleaning of the pool or spa.

A6.1.15.1. **Monitoring.** Measure the TDS concentration in pools, spas, and hot tubs every two weeks. When the TDS concentration exceeds the startup concentration by 1,500 ppm or more, partially drain and refill the pool to reduce it to acceptable levels.

## A6.2. Turnover Rate.

A6.2.1. The turnover rate is the time taken for all of the water in a pool to be circulated through the pump/filter system. The turnover rate is calculated by the following formula:

$$\text{Turnover rate (hours)} = \text{Pool volume (gal)} \div \text{Flow rate (gal/min)} \div 60 \text{ (min/hour)}$$

To determine the flow rate required to achieve a turnover rate of 6 hours, use the following formula:

$$\text{Flow rate (gal/min)} = \text{Pool volume (gal)} \div 360 \text{ min}$$

Turnover rate shall not exceed 6 hours, or 360 minutes.

A6.2.2. The turnover rate for wading pools/baby pools shall be one hour.

Table A6.1 lists some common pool water quality problems, potential causes, and potential solutions.<sup>5</sup>

**Table A6.1. Pool Water Quality Problem Solving.**

Water Quality Problem	Potential Causes	Potential Solutions
Cloudy water	Inadequate turnover rate	Check pump capacity and flow rate.
	Filter media corrupted, channeled, or creviced	If sand, clean filter and replace media, if necessary. If diatomaceous earth (DE) filter, wash filter bags in weak acid solution.
	Excessive filter pressure	Backwash filter, bleed air pressure from filter shell, check pump for

<sup>5</sup>Centers for Disease Control and Prevention and U.S. Department of Housing and Urban Development. Healthy housing reference manual. 2006.

		proper sizing.
	High pH or alkalinity above 180 ppm	Reduce pH to maximum of 7.8 and alkalinity to less than 180 ppm.
	Test for excessive CYA	Ensure chlorine levels are able to oxidize organics
Dull green color	Algae growth	Shock treat, then maintain pH at 7.8 and disinfectant residual of 1 ppm or higher
Respiratory, skin, eye, mucous membrane irritations, strong swimming pool odor	Combined chlorine in excess of 0.5 ppm	Chlorine must be added to the pool water until breakpoint chlorination* is achieved.
<p>* Other compounds in the water, such as sweat from bathers' bodies, combine with chlorine and "use up" some of its disinfecting power. A sufficient quantity of chlorine must be added to the water so that, after the chlorine demand is met, there is still some chlorine left to kill microorganisms in the water. This is called breakpoint chlorination.</p>		

## Attachment 7

RESPONSE TO FECAL, AND VOMIT, INCIDENTS<sup>6</sup>

**A7.1. Formed Stool and Vomit Incidents.** Close the pool to swimmers and notify Public Health. In cases of multiple pools that use the same filtration system – all pools will have to be closed to swimmers. Do not allow anyone to enter the pool(s) until the disinfection process is completed.

A7.1.1. Remove as much of the fecal matter or vomit as possible (for example, using a net or a bucket) and dispose of it in a sanitary manner. Clean and disinfect the items used to remove the fecal matter or vomit (for example, after cleaning, leave the net or bucket immersed in the pool during disinfection.)

A7.1.2. Do not vacuum stool or vomit from the pool.

A7.1.3. Raise the free chlorine to 2 ppm, if less than 2 ppm, and ensure pH 7.5 or less and a temperature of 77°F or higher. This chlorine concentration will keep the pool closure time to 30 minutes. It is important to note this procedure applies only to formed stool and vomit incidents, because these types of incidents carry a low risk of *Cryptosporidium*. However, a diarrheal incident has a higher risk of *Cryptosporidium* and requires a more robust response, as described in paragraph “Diarrheal Incidents” below.

A7.1.4. Other concentrations or closure times can be used as long as the CT inactivation value is achieved (see paragraph 4.1.4.3 for a discussion of CT values). Please note, a longer CT is needed if a chlorine stabilizer (CYA) is used.

A7.1.5. Maintain free chlorine concentration at 2 ppm and pH 7.5 or less for at least 30 minutes before re-opening the pool. Ensure the filtration system is operating while the pool reaches and maintains the proper free chlorine concentration during the disinfection process.

**A7.2. Diarrheal Incidents.** Close the pool to swimmers for the remainder of the day and notify Public Health. If you have multiple pools that use the same filtration system – all pools will have to be closed to swimmers. Do not allow anyone to enter the pool(s) until the next business day.

A7.2.1. Remove as much of the fecal matter as possible (for example, using a net or a bucket) and dispose of it in a sanitary manner. Clean and disinfect the items used to remove the fecal matter (for example, after cleaning, leave the net or bucket immersed in the pool during disinfection.)

A7.2.2. Do not vacuum stool from the pool.

A7.2.3. Before attempting the hyperchlorination of any pool, consult CE and/or BE to determine the feasibility, the most optimal and practical methods, and needed safety considerations.

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<sup>6</sup> Centers for Disease Control and Prevention. *Fecal Incident Response Recommendations for Pool Staff*. 15 Nov 2010. <http://www.cdc.gov/healthywater/swimming/pools/vomit-blood-contamination.html>

A7.2.4. Raise the free chlorine concentration to 20 ppm and maintain pH 7.5 or less and a temperature at 77°F or higher. The free chlorine and pH shall remain at these levels for at least 12.75 hours to achieve the CT inactivation value of 15,300.

A7.2.5. Confirm that the filtration system is operating while the water reaches, and is maintained, at the proper chlorine level for disinfection.

A7.2.6. Backwash the filter after reaching the CT inactivation value. Be sure the effluent is discharged directly to waste and in accordance with state or local regulations. Do not return the backwash through the filter. Where appropriate, (e.g., if using cartridge or diatomaceous earth filters) replace the filter media.

A7.2.7. Swimmers shall not be allowed into the pool until the next business day after a diarrheal incident. Notify Public Health before re-opening the pool, and ensure the required CT inactivation value has been achieved and the free chlorine and pH levels have been returned to the normal operating range.